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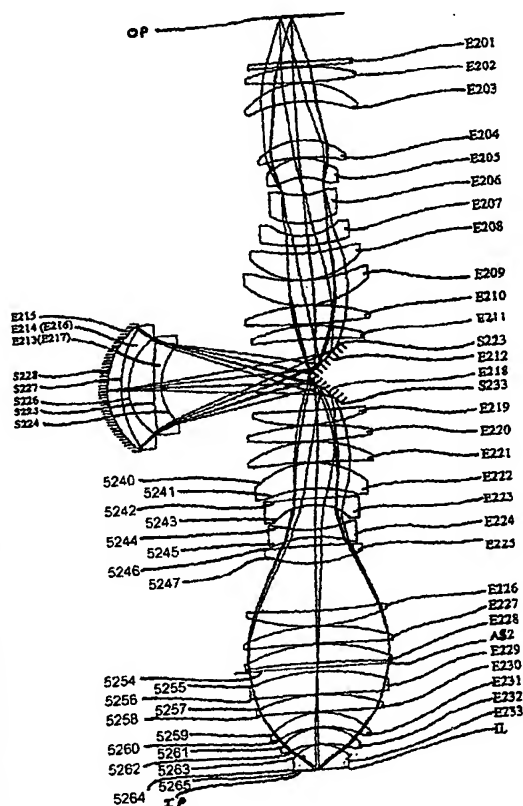
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[Continued on next page]

(54) Title: **PROJECTION OPTICAL SYSTEM AND METHOD FOR PHOTOLITHOGRAPHY AND EXPOSURE APPARATUS AND METHOD USING SAME**



(57) Abstract: Optical Projection System and Method for Photolithography. A lithographic immersion projection system and method for projecting an image at high resolution over a wide field of view. The projection system and method include a final lens which decreases the marginal ray angle of the optical path before light passes into the immersion liquid to impinge on the image plane.

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INTERNATIONAL SEARCH REPORT

Intr. Application No
PCT/JP 03/10665

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G03F7/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G03F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 191 429 B1 (SUWA KYOICHI) 20 February 2001 (2001-02-20) column 3, line 17 - line 33	1,8
A	EP 0 605 103 B (CANON KK) 14 October 1998 (1998-10-14) claim 1	1,8
P,X	US 2003/030916 A1 (SUENAGA YUTAKA) 13 February 2003 (2003-02-13) paragraph [0057]; figure 6 paragraph [0066] - paragraph [0070]; table 3	1,8,15, 22,23
P,X	JP 2002 244035 A (NIKON CORP) 28 August 2002 (2002-08-28) figure 6	1,8,15, 22,23
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the International filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

11 May 2004

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12.08.2004

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 03/10665

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	<p>WO 03/077037 A (CARL ZEISS SMT AG) 18 September 2003 (2003-09-18) page 15, line 5 - line 9; figure 1; table 1</p> <p style="text-align: center;">-----</p>	1,23

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP 03/10665

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-23

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/ JP 03/ 10665

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-23

prior art:

projection optical system for immersion lithography

special technical feature:

boundary lens of projection optical system having a specific shape

problem:

marginal convergence angle of light prior to incidence on the boundary lens is larger than its convergence angle within the boundary lens

2. claims: 24-43

special technical feature:

specification about immersion liquid

problem:

refractive index of immersion liquid larger than 1.1

INTERNATIONAL SEARCH REPORT

on patent family members

Intern. Application No
PCT/ 03/10665

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 6191429	B1	20-02-2001	US	5825043 A	20-10-1998
			EP	0834773 A2	08-04-1998
			JP	10154659 A	09-06-1998
EP 0605103	B	06-07-1994	JP	2753930 B2	20-05-1998
			JP	6168866 A	14-06-1994
			DE	69321571 D1	19-11-1998
			DE	69321571 T2	08-04-1999
			EP	0605103 A1	06-07-1994
			US	5610683 A	11-03-1997
US 2003030916	A1	13-02-2003	JP	2002244035 A	28-08-2002
			TW	512237 B	01-12-2002
			US	2004021844 A1	05-02-2004
JP 2002244035	A	28-08-2002	CN	1423147 A	11-06-2003
			TW	512237 B	01-12-2002
			US	2003030916 A1	13-02-2003
			US	2004021844 A1	05-02-2004
WO 03077037	A	18-09-2003	DE	10210899 A1	18-09-2003
			WO	03077036 A1	18-09-2003
			WO	03077037 A1	18-09-2003
			US	2003174408 A1	18-09-2003